

Claims

1. A method of making a via hole in a semiconductor structure, the via hole having a surface layer of hydrophobic material, the via hole comprising an outer layer of material having a characteristic of spin on glass materials, the characteristic being that the outer layer oxidizes during photoresist ashing to form a surface layer of silicon dioxide in the via hole; the method comprising the operation of:

performing a chemical dehydroxylation operation after the ashing on the surface layer of silicon dioxide to convert the surface layer of silicon dioxide to the surface layer of hydrophobic material.

2. The method of claim 1, wherein the material of the outer layer having the characteristic of spin on glass is taken from the group consisting of spin on glass and an organic vapor-deposited low thermal expansion coefficient material.

3. The method of claim 1, wherein the performing of the operation of chemical dehydroxylation is by the operations of:

placing the semiconductor structure in a closed process chamber, the semiconductor structure having the via hole with the surface layer of silicon dioxide; and

admitting into the process chamber a halogen compound configured to facilitate for the chemical dehydroxylation operation.

4. The method of claim 3, further comprising:

performing the admitting operation until the pressure in the chamber is from about 1.5 to about 3 atmospheres;

maintaining a temperature in the chamber from about 100 degrees C to less than about 450 degrees C; and

5 performing the admitting and maintaining operations for a period ranging between about 1 minute and about 4 minutes.

5. The method according to claim 1, wherein the chemical dehydroxylation operation produces by-products, and further comprising:

10 removing the by-products from the chamber.

6. The method according to claim 3, wherein the halogen compound is NH_4F .

15 7. The method according to claim 3, wherein the halogen compound is CCl_4 .

8. The method according to claim 7, further comprising:

depositing a layer of titanium nitride (TiN) in the via hole over the surface layer of hydrophobic material.

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9. The method according to claim 3, further comprising:

pressurizing the chamber with the halogen compound from about 1.5 to about 3 atmospheres.

10. The method according to claim 9, wherein the pressurizing is at a pressure of about 2.0 atmospheres.

11. The method according to claim 3, wherein the operation of admitting the halogen compound into the process chamber is performed at a rate ranging between about 10 sccm and about 50 sccm.

12. The method according to claim 3, wherein the operation of admitting the halogen compound into the process chamber is performed at a temperature of about 100 degrees C to about 300 degrees C.

13. The method according to claim 2, wherein the material of the **outer** layer is spin on glass and the chemical dehydroxylation operation is performed on the surface layer of silicon dioxide using NH_4F to convert the surface layer of silicon dioxide to the hydrophobic material.

14. The method according to claim 13, further comprising:
performing the chemical dehydroxylation operation for a period of about 2 minutes.

15. A method of making a via hole in a semiconductor device, the method comprising;

defining a via hole having a wall surface that at least partially has a characteristic of spin on glass materials, the characteristic being that the wall surface oxidizes during a photoresist ashing operation and the oxidizing converts the wall surface into a silicon dioxide skin;

placing the semiconductor device in a process chamber; and

introducing a halogen gas into the process chamber to cause a chemical dehydroxylation of silicon dioxide skin to thereby convert the silicon dioxide skin into a hydrophobic material skin, the hydrophobic skin being part of the wall surface of the via hole.

16. The method of claim 15, wherein the halogen gas is selected from one of an NH_4F gas and a CCl_4 gas.

17. The method according to claim 15, wherein the process chamber is maintained at a pressure ranging between about 1.5 and about 3 atmospheres.

18. The method of claim 16, wherein the hydrophobic material skin is one of an Si_3F and a CCl_4F .

19. The method of claim 16, further comprising:

maintaining a temperature of the process chamber from about 100 degrees C to less than about 450 degrees C.

20. The method of claim 16, wherein the converting is performed during a time period ranging between about one minute and about four minutes.

5 21. A semiconductor via structure being defined through an inter-metal dielectric, comprising:

a first conductive pattern element; and

a layer of SOG material formed over the first conductive pattern element, the layer of SOG material having a via hole defined therethrough, such that the via hole
10 defines a path to the first conductive pattern element,

wherein the via hole has a via wall surface, the via wall surface is defined along the SOG material that extends to the first conductive pattern element, and the via wall surface has a hydrophobic material layer.

15 22. A semiconductor via structure being defined through an inter-metal dielectric as recited in claim 21, wherein the hydrophobic material layer is a reaction product of silicon dioxide and a halogen compound.

23. A semiconductor via structure being defined through an inter-metal
20 dielectric as recited in claim 22, wherein the halogen compound is NH_4F .

24. A semiconductor via structure being defined through an inter-metal dielectric as recited in claim 22, wherein the halogen compound is CCl_4 .

25. A semiconductor via structure being defined through an inter-metal dielectric as recited in claim 23, further comprising:

a layer coating the via hole in direct substantially continuous contact with the hydrophobic material layer, the layer coating being a titanium nitride material.

26. A semiconductor via structure being defined through an inter-metal dielectric as recited in claim 25, further comprising:

a conductive fill material contained within the via hole and in direct substantially continuous contact with the layer coating.

27. A semiconductor via structure being defined through an inter-metal dielectric as recited in claim 26, further comprising:

a second conductive pattern element in conductive contact with the conductive fill material, the titanium nitride material, and the first conductive pattern element, thereby defining a reliable conductive interconnection between a first metal layer network that includes the first conductive pattern element and a second metal layer network that includes the second conductive pattern element.

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